

From AP-42 - Figure 4.3.4 - Use equations

Kg - Eq. 2
Koil - Eq. 9
N - Eq. 22

Eq. 2

$$Kg \text{ (m/s)} = (4.82 \times 10^{-3}) * (U10)^{0.78} * (ScG)^{-0.67} * (de)^{-0.11}$$

where:

$$ScG = (\mu a) / (\rho a) * (Da)$$

$$de = 2 * [(A) / (\pi)]^{0.5}$$

ScG	1.994
de	48.19

Kg = 0.0064 (m/s)

Eq. 9

$$Koil = Kg * Keq.oil$$

where:

$$Keq.oil = [(P^*) * (\rho a) * (MWoil)] / [(\rho oil) * (MWa) * (Po)]$$

Keq.oil =	0.0002
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Koil = 0.000001 (m/s)

Eq. 22

$$N \text{ (g/s)} = (Koil) * (CL.oil) * (A)$$

where:

$$CL.oil = [(Qoil) * (Co.oil^*)] / [(Koil) * (A) + (Qoil)]$$

and

$$Co.oil^* = (Co) / (FO) = 240$$

$$Qoil = (FO) * (Q) = 2.629E-06$$

CL.oil =	0.6383765
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N (g/s) = 0.001 (g/s)

43.7 lb/yr

Ethylbenzene

Variables:

μa	0.000181 g/cm-s	
ρa	0.00121 g/cm ³	
Da	0.075	
L	150 ft	45.7 m
W	50 ft	15.2 m
π	3.1415927	
U10	4.47 m/s	
P*	0.0131579 atm	
MWoil	282 g/g-mol	
ρoil	0.92 g/cm ³	
MWa	29 g/g-mol	
Po	0.758 atm	
Co	0.24 g/m ³	
FO	0.001	
Q	0.0026288 m ³ /s	21,900,000 gal/yr

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Eq. 2

$$Kg \text{ (m/s)} = (4.82 \times 10^{-3}) * (U10)^{0.78} * (ScG)^{-0.67} * (de)^{-0.11}$$

where:

$$ScG = (\mu a) / (\rho a) * (Da)$$

$$de = 2 * [(A) / (\pi)]^{0.5}$$

ScG	1.719
de	48.19

Kg = 0.0070 (m/s)

Eq. 9

$$Koil = Kg * Keq.oil$$

where:

$$Keq.oil = [(P^*) * (\rho a) * (MWoil)] / [(\rho oil) * (MWa) * (Po)]$$

Keq.oil =	0.0007
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Koil = 0.000005 (m/s)

Eq. 22

$$N \text{ (g/s)} = (Koil) * (CL.oil) * (A)$$

where:

$$CL.oil = [(Qoil) * (Co.oil^*)] / [(Koil) * (A) + (Qoil)]$$

and

$$Co.oil^* = (Co) / (FO) = 3600$$

$$Qoil = (FO) * (Q) = 2.629E-06$$

CL.oil =	2.8951252
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N (g/s) = 0.009 (g/s)

656.8 lb/yr

Toluene

Variables:

μa	0.000181 g/cm-s	
ρa	0.00121 g/cm ³	
Da	0.087	
L	150 ft	45.7 m
W	50 ft	15.2 m
π	3.1415927	
U10	4.47 m/s	
P*	0.0394737 atm	
MWoil	282 g/g-mol	
ρoil	0.92 g/cm ³	
MWa	29 g/g-mol	
Po	0.758 atm	
Co	3.6 g/m ³	
FO	0.001	
Q	0.0026288 m ³ /s	21,900,000 gal/yr

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Eq. 2

$$Kg \text{ (m/s)} = (4.82 \times 10^{-3}) * (U10)^{0.78} * (ScG)^{-0.67} * (de)^{-0.11}$$

where:

$$ScG = (\mu a) / (\rho a) * (Da)$$

$$de = 2 * [(A) / (\pi)]^{0.5}$$

ScG	2.137
de	48.19

Kg = 0.0061 (m/s)

Eq. 9

$$Koil = Kg * Keq.oil$$

where:

$$Keq.oil = [(P*) * (\rho a) * (MWoil)] / [(\rho oil) * (MWa) * (Po)]$$

Keq.oil =	0.0002
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Koil = 0.000001 (m/s)

Eq. 22

$$N \text{ (g/s)} = (Koil) * (CL.oil) * (A)$$

where:

$$CL.oil = [(Qoil) * (Co.oil*)] / [(Koil) * (A) + (Qoil)]$$

and

$$Co.oil* = (Co) / (FO) = 1900$$

$$Qoil = (FO) * (Q) = 2.629E-06$$

CL.oil =	6.610703
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N (g/s) = 0.005 (g/s)

345.7 lb/yr

Total BTEX: 1922.5 lb/yr

Xylene

Variables:

μa	0.000181 g/cm-s	
ρa	0.00121 g/cm ³	
Da	0.07	
L	150 ft	45.7 m
W	50 ft	15.2 m
π	3.1415927	
U10	4.47 m/s	
P*	0.0105263 atm	
MWoil	282 g/g-mol	
ρoil	0.92 g/cm ³	
MWa	29 g/g-mol	
Po	0.758 atm	
Co	1.9 g/m ³	
FO	0.001	
Q	0.0026288 m ³ /s	21,900,000 gal/yr

Sump BTEX Emissions

Equation 1

$$K_i \text{ (m/s)} = (2.78 \times 10^{-6}) \times (D_w/D_{\text{ether}})^{2/3}$$

$$K_i = 0.00000305667709467$$

Benzene

$$D_w = 0.0000098 \text{ value provided in table 4.3-2 for benzene}$$

$$D_{\text{ether}} = 0.0000085 \text{ value provided in table 4.3-2}$$

Equation 2

$$K_g \text{ (m/s)} = (4.82 \times 10^{-3}) \times (U_{10})^{0.78} \times (S_{CG})^{-0.2/3} \times (d_e)^{-0.11}$$

$$S_{CG} = \frac{u_a}{\rho_a \times D_a}$$

$$S_{CG} = 1.714015152$$

$$K_g = 0.003169658$$

$$U_{10} = 1 \text{ Assumed wind speed of 1 m/s}$$

$$d_e = 1.7242092 \text{ Longest dimension of each sump in meters}$$

$$u_a = 0.000181 \text{ Viscosity of air cm}^2/\text{sec}$$

$$\rho_a = 0.0012 \text{ g/cm}^3 \text{ viscosity of Air}$$

$$D_a = 0.088 \text{ cm}^2/\text{sec}$$

Equation 7

$$K = (k_i \times K_{eq} \times k_g) / (K_{eq} \times k_g + k_i)$$

$$K_{eq} = H/(RT)$$

$$K_{eq} = 0.224690504$$

$$K = 3.04361E-06$$

$$H = 0.0055 \text{ Henry's Law for benzene}$$

$$R = 0.0000821 \text{ Universal Gas Constant}$$

$$T = 298.15 \text{ Degrees Kelvin}$$

Equation 12

$$N \text{ (g/s)} = K \times C_L \times A$$

$$C_L = Q \times C_o / K \times A + Q$$

$$C_L = 4.594414501$$

$$N = 0.000540434 \text{ grams/sec}$$

$$37.56308338 \text{ pounds per year}$$

$$A = 38.647666 \text{ Area of all sumps combined in meters squared sumps are 4 feet by 4 feet and there are 26}$$

$$Q = 0.0026288 \text{ m}^3/\text{sec}$$

$$C_o = 4.8 \text{ measured value in mg/L}$$

Equation 1

$$K_i \text{ (m/s)} = (2.78 \times 10^{-6}) \times (D_w/D_{\text{ether}})^{2/3}$$

$$K_i = 0.00000262519708835$$

Ethylbenzene

$$D_w = 0.0000078 \text{ value provided in table 4.3-2 for ethylbenzene}$$

$$D_{\text{ether}} = 0.0000085 \text{ value provided in table 4.3-2}$$

Equation 2

$$K_g \text{ (m/s)} = (4.82 \times 10^{-3}) \times (U_{10})^{0.78} \times (S_{CG})^{-0.2/3} \times (d_e)^{-0.11}$$

$$S_{CG} = u_a / (\rho_a \times D_a)$$
$$S_{CG} = 2.011111111$$

$$K_g = 0.002849256$$

$$U_{10} = 1 \text{ Assumed wind speed of 1 m/s}$$

$$d_e = 1.7242092 \text{ Longest dimension of each sump in meters}$$

$$u_a = 0.000181 \text{ Viscosity of air cm}^2/\text{sec}$$

$$\rho_a = 0.0012 \text{ g/cm}^3 \text{ viscosity of Air}$$

$$D_a = 0.075 \text{ cm}^2/\text{sec}$$

Equation 7

$$K = (k_i \times K_{\text{eq}} \times k_g) / (K_{\text{eq}} \times k_g + k_i)$$

$$K_{\text{eq}} = H / (RT)$$

$$K_{\text{eq}} = 0.224690504$$

$$K = 2.61448E-06$$

$$H = 0.0055 \text{ Henry's Law for benzene}$$

$$R = 0.0000821 \text{ Universal Gas Constant}$$

$$T = 298.15 \text{ Degrees Kelvin}$$

Equation 12

$$N \text{ (g/s)} = K \times C_L \times A$$

$$C_L = Q \times C_0 / (K \times A + Q)$$

$$C_L = 0.231116416$$

$$N = 2.33528E-05 \text{ grams/sec}$$

$$1.623143655 \text{ pounds per year}$$

$$A = 38.647666 \text{ Area of all sumps combined in meters squared sumps are 4 feet by 4 feet and there are 26}$$

$$Q = 0.0026288 \text{ m}^3/\text{sec}$$

$$C_0 = 0.24 \text{ measured value in mg/L}$$

Equation 1

$$K_l \text{ (m/s)} = (2.78 \times 10^{-6}) \times (D_w/D_{\text{ether}})^{2/3}$$

$$K_l = 0.00000280176139080$$

Toluene

$$D_w = 0.0000086 \text{ value provided in table 4.3-2 for toluene}$$

$$D_{\text{ether}} = 0.0000085 \text{ value provided in table 4.3-2}$$

Equation 2

$$K_g \text{ (m/s)} = (4.82 \times 10^{-3}) \times (U_{10})^{0.78} \times (S_{CG})^{-0.2/3} \times (d_e)^{-0.11}$$

$$S_{CG} = u_a / (\rho_a \times D_a)$$
$$S_{CG} = 1.733716475$$

$$K_g = 0.003145599$$

$$U_{10} = 1 \text{ Assumed wind speed of 1 m/s}$$

$$d_e = 1.7242092 \text{ Longest dimension of each sump in meters}$$

$$u_a = 0.000181 \text{ Viscosity of air cm}^2/\text{sec}$$

$$\rho_a = 0.0012 \text{ g/cm}^3 \text{ viscosity of Air}$$

$$D_a = 0.087 \text{ cm}^2/\text{sec}$$

Equation 7

$$K = (k_l \times K_{\text{eq}} \times k_g) / (K_{\text{eq}} \times k_g + k_l)$$

$$K_{\text{eq}} = H / (RT)$$

$$K_{\text{eq}} = 0.224690504$$

$$K = 2.7907\text{E-}06$$

$$H = 0.0055 \text{ Henry's Law for benzene}$$

$$R = 0.0000821 \text{ Universal Gas Constant}$$

$$T = 298.15 \text{ Degrees Kelvin}$$

Equation 12

$$N \text{ (g/s)} = K \times C_L \times A$$

$$C_L = Q \times C_0 / (K \times A + Q)$$

$$C_L = 3.458118568$$

$$N = 0.000372972 \text{ grams/sec}$$

$$25.92354073 \text{ pounds per year}$$

$$A = 38.647666 \text{ Area of all sumps combined in meters squared sumps are 4 feet by 4 feet and there are 26}$$

$$Q = 0.0026288 \text{ m}^3/\text{sec}$$

$$C_0 = 3.6 \text{ measured value in mg/L}$$

Equation 1

$$K_l \text{ (m/s)} = (2.78 \times 10^{-6}) \times (D_w/D_{\text{ether}})^{2/3}$$

$$K_l = 0.00000262519708835$$

Xylene

$$D_w = 0.0000078 \text{ value provided in table 4.3-2 for xylene}$$

$$D_{\text{ether}} = 0.0000085 \text{ value provided in table 4.3-2}$$

Equation 2

$$K_g \text{ (m/s)} = (4.82 \times 10^{-3}) \times (U_{10})^{0.78} \times (S_{CG})^{-0.2/3} \times (d_e)^{-0.11}$$

$$S_{CG} = u_a / (\rho_a \times D_a)$$
$$S_{CG} = 2.154761905$$

$$K_g = 0.002721172$$

$$U_{10} = 1 \text{ Assumed wind speed of 1 m/s}$$

$$d_e = 1.7242092 \text{ Longest dimension of each sump in meters}$$

$$u_a = 0.000181 \text{ Viscosity of air cm}^2/\text{sec}$$

$$\rho_a = 0.0012 \text{ g/cm}^3 \text{ viscosity of Air}$$

$$D_a = 0.07 \text{ cm}^2/\text{sec}$$

Equation 7

$$K = (k_l \times K_{\text{eq}} \times k_g) / (K_{\text{eq}} \times k_g + k_l)$$

$$K_{\text{eq}} = H / (RT)$$

$$K_{\text{eq}} = 0.224690504$$

$$K = 2.61397\text{E-}06$$

$$H = 0.0055 \text{ Henry's Law for benzene}$$

$$R = 0.0000821 \text{ Universal Gas Constant}$$

$$T = 298.15 \text{ Degrees Kelvin}$$

Equation 12

$$N \text{ (g/s)} = K \times C_L \times A$$

$$C_L = Q \times C_0 / (K \times A + Q)$$

$$C_L = 1.829684644$$

$$N = 0.000184842 \text{ grams/sec}$$

$$12.84750908 \text{ pounds per year}$$

$$A = 38.647666 \text{ Area of all sumps combined in meters squared sumps are 4 feet by 4 feet and there are 26}$$

$$Q = 0.0026288 \text{ m}^3/\text{sec}$$

$$C_0 = 1.9 \text{ measured value in mg/L}$$

Total BTEX: 78.0 lb/yr